2-LAYERS TBC BY EBPVD

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Although EB PVD metal coatings have been widely used for many years, one of their drawbacks is the presence of growth defects, so-called leaders. Leaders are the linear structural defects that allow for such reactive elements as oxygen to infiltrate (penetrate) to the substrate surface along the inner surfaces of the leaders, and oxidation or corrosion of the substrate surface (airfoil surface) takes place. This problem was solved by application of EB PVD high-rate metal ingot evaporation method for deposition of metal coating having general composition of MCrAIY(X) where M is Fe, Ni, Co, or Ni/Co and X – Si, Ti, Zr, Ce etc, it allows us to solve the problems with adhesion, make this method less expensive with good performance rate and form the leader-free structure. Selection of parameters provides full reproduction of evaporated material composition in deposited coating and obtaining leader-free structure. A deposited material has some growth defects that can be easily eliminated by thermal treatment at moderate temperature. The structure of the as-deposited coating is characterized by the non-equilibrium fine grain microstructure that features abnormal physical properties, including accelerated internal boundary diffusion. In this case, the phase composition has been identified as supersaturated M-based solid solution with extremely large area of interfaces. During exposure at the temperatures below the transition temperature, the as-deposited structure evolves towards the more equilibrium configuration. Diffusion activated transformations of γ-supersaturated phase into γ/β equilibrium state is the cause of volume change, effective «healing» of the existing defects and reducing possibility of new ‘leaders’ appearance. Over the last years, the EB PVD process has been widely used for metal coating deposition on the 1st and 2nd stages blades and vanes of gas turbine Aero and Industrial engines, having MCrAIY(X) general composition. Metal chemical composition depends on the superalloy type and operation conditions. Metal coating has been used either by itself as a protective (barrier) coating (overlay) or as a bond coat for multi-layer coating system (TBC). 2-layers TBC deposited by EBPVD onto the airfoils where the ceramic top coat layer of yttria stabilized zirconia (YSZ) has the strain columnar structure that prevents the failure due to thermocycling stresses and shows the perfect adhesion, smooth airfoil surface and no cooling holes blockage.